REMARKS/ARGUMENTS

Favorable consideration of this application, in light of the present amendments and following discussion is respectfully requested.

Claims 1-23 have been canceled without prejudice by the present amendment; Claims 24-32 have been added by the present amendment. It is respectfully submitted that no new matter is added by this amendment, as support for the new claims may be found, at least, in Figures 1A-1D and 2, as well as in pages 63-80 of the specification and in original Claims 1-11.

In the Office Action, the drawings were objected to. The specification was objected to. Claim 14 was rejected under 35 U.S.C. § 102(b) as being anticipated by Ishii (U.S. Pat. No. 6,796,268) (herein designated reference 1). Claims 1, 2, 4, 9, and 11 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Naoki (Jap. Pat. Appln. KOKAl Publication No. 11-111493) (herein designated reference 2) in view of Yuichi et al (Jap. Pat. Appln. KOKAl Publication No. 2002-280196) (herein designated reference 3). Claims 3 and 10 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Naoki in view of Yuichi et al and further in view of Noguchi (U.S. Pat. No. 6,607,633) (herein designated reference 4). Claim 5 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Naoki in view of Yuichi et al and further in view of Mabuchi et al (U.S. Pat. No. 5,788,798) (herein designated reference 5). Claim 15 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Ishii in view of Tadera et al (U.S. Pat. No. 6,726,802) (herein designated reference 6). Claim 16 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Ishii in view of Tadera et al and further in view of Mabuchi et al (Jap. Pat. Appln. KOKAl Publication No. 8-316198) (herein designated reference 7). Claim 17 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Ishii in view of Tadera et al and Mabushi et al and further in view of Mabuchi et al (U.S. Pat. No. 5,645,644) (herein designated reference 8).

Regarding the objection to the drawings, reference element 22 is shown in Applicants' Figure 19B. The reference to this element in Figure 16 in the specification has been removed by the present amendment to the specification. Thus, the objection to the drawings should be removed.

Regarding the objection to the specification, the specification on page 91 has been amended as suggested in the Office Action. Thus, the objection to the specification has been overcome.

The present invention:

The plasma processing apparatus of the present invention is described in new Claims 24-34 and the structure and advantage thereof are summarized as follows:

Regarding Claim 24, the slots can be distributed substantially uniformly over the entire area that is to be subjected to plasma processing by providing a structure in which the adjacent waveguides of the plurality of linear and rectangular waveguides are in contact with each other. Furthermore, the transmission path of the electromagnetic waves is bent through substantially 90° to the plurality of linear and rectangular waveguides from the electromagnetic wave distributing waveguide, and the plurality of rectangular waveguides and the electromagnetic wave distributing waveguide are arranged on substantially the same plane. Thus, a substrate having a large area can be processed in the same step, and a plasma processing apparatus that has a small footprint and a uniform plasma density can be obtained.

Regarding Claim 25, the slots can be distributed substantially uniformly over the entire area that is to be subjected to plasma processing by providing a structure in which the adjacent waveguides of the plurality of linear and rectangular waveguides are in contact with each other at their elongated side faces. Furthermore, as the transmission path of the electromagnetic waves is bent through substantially 90° to the plurality of linear and

rectangular waveguides from the electromagnetic wave distributing waveguide, the plural rectangular waveguides and the electromagnetic wave distributing waveguide are arranged on substantially the same plane, and the plurality of linear and rectangular waveguides are branched from the electric field plane or the plane perpendicular to the magnetic field plane of the electromagnetic wave distributing waveguide. A substrate having a large area can therefore be processed in the same step, and a plasma processing apparatus that has a small footprint and a uniform plasma density can be obtained.

The applied references:

Regarding reference 1, as shown in FIGS. 1a and 1b, Applicants submit that a transmission window 10 for transmitting microwaves is provided on the surface of a processing vessel 1, and a microwave antenna 2 is attached to the transmission window 10. The microwave antenna 2 has two ring-shaped antenna waveguides 5a and 5b that are concentrically arranged.

Reference 1 discloses a microwave plasma processing apparatus connected to a microwave supply source 3 via a connecting waveguide 4. The apparatus includes the ring-shaped antenna waveguides 5a and 5b which are rectangular waveguides that have a plurality of slots 6a and 6b on an H-plane (i.e., the magnetic field plane).

Regarding reference 2, as indicated in numbered paragraphs 0024 and 0025, and as shown in FIG. 1, Applicants submit that reference 2 discloses a plasma processing apparatus in which a microwave entrance window 4 is hermetically provided on the upper portion of a reaction chamber 1, and a dielectric line 28 enclosed by a metal plate 22 via an air gap 20 is provided on the upper portion of the microwave entrance window 4. The side of the dielectric line 28 is connected to a microwave oscillator 26 via a microwave distributor 27.

Regarding reference 3, as indicated in paragraphs 0015, 0016, and 0019, and shown in FIGS. 1-4, Applicants submit that reference 3 discloses a plasma generating apparatus 40 in which three waveguides 42, 43, and 44 are provided in parallel and at intervals on the surface of a plasma generating chamber 41, and a plurality of round connecting holes 42a, 42b, and 42c are provided on waveguides 42-44. A round dielectric window 45 which is smaller than the connecting holes 42a, 42b, and 42 c is provided on the surface of the plasma generating chamber 41 facing the connecting holes 42a, 42b, and 42c.

Regarding reference 4, as shown in Fig. 3, Applicants submit that reference 4 discloses a plasma processing apparatus in which a radiative part 12 is provided, via a waveguide 11 connected to the microwave oscillator, on a dielectric window 31 structuring the surface of a plasma generating device 30, and a plurality of slot antennas 13 are formed on the opposing surface of the dielectric window 31 of the waveguide 11. A movable plate 16 on sidewalls 14 and 15 of the waveguide 11 is projected inwards to the waveguide 12, the wavelength of the microwave propagating in the waveguide 12 is changed, and the plasma distribution in the vicinity of the subject to be processed is made even.

Regarding reference 5, as shown in Figs. 8 and 9, Applicants submit that reference 5 discloses a plasma apparatus in which a dielectric sheet 21 a having a tapered portion is provided, via a space, on a microwave window 4 structuring the surface of a reaction chamber 1, the dielectric sheet 21 a is provided with a microwave guide path 23 connected to a microwave generator 26, and a tuner 24 and an isolator 25a are provided on the microwave guide path 23. Due to the above structure, the plasma apparatus of reference 5 can carry out adjustments to match microwaves and to propagate microwaves evenly by the dielectric sheet 21 a.

Regarding reference 6, as shown in FIG. 4, Applicants submit that reference 6 discloses a plasma etching apparatus in which a plurality of waveguides 3 are provided at

intervals on a top chamber lid 1 of a chamber body 2, a slot plate 4 on which sets of slots are provided on the opposing surface of the top chamber lid 1 of the waveguides 3, and a laminated structure of a microwave entrance window 11 and a dielectric plate 15 are provided on the top chamber lid 1 facing the sets of slots 4b. The slot plate 4 is moved, according to the type of etching film of the subject to be processed, such that the subject requires one to select the desired sets of slots 4b.

Regarding reference 7, as indicated in paragraph 0033 and as shown in Fig. 6, Applicants submit that reference 7 discloses a plasma apparatus in which a dielectric layer 21 a having a tapered portion is provided, via a space, on a microwave introduction window 4 structuring the surface of a reaction chamber 1, a microwave waveguide 23 connected to a microwave oscillator 26 is provided on the dielectric layer 21 a, and a tuner 24a and an isolator 25a are provided on the microwave waveguide 23. Due to the above structure, Applicants submit that the plasma apparatus of reference 7 can carry out adjustments to match microwaves, and to propagate the microwaves evenly by the dielectric layer 21a.

Regarding reference 8, as shown in Figs. 2A and 2B, Applicants submit that reference 8 discloses a plasma generating device in which a dielectric sheet 21 is provided, via a gap, on microwave windows 2a and 2b structuring the surface of a reaction chamber 1, a waveguide 23 connected to a microwave generator 24 is connected to the dielectric sheet 21, and window supporting members 5 formed of a frame 5a and crossing beams 6 are provided on the dielectric sheet 21.

Comparison between the present invention and the references:

Regarding reference 1 and new claim 29 (similar to original claim 14), dependent claim 29 is characterized by the even distribution of a plurality of slots throughout the entire area where plasma is processed as defined new claim 24. On the other hand, reference 1

discloses a microwave plasma processing apparatus in which a plurality of ring-shaped waveguides are arranged on the same axis. That is, for waveguides in the present invention, the waveguides are provided along the entire surface of the electromagenetic wave radiation windows, whereas in reference 1 there is a broad region in the central part where no waveguides exist. Thus, the structures of the present invention defined in Claim 29 and reference 1 are different.

Moreover, in reference 1, Applicants submit that, although a waveguide is formed so as to be multiplex and ring shaped, the method in reference 1 requires a plurality of ring shaped waveguides to be superimposed to permit the processing of large areas. Thus, reference 1 is not suitable for applications that involve large areas. There is also the problem that the design of the waveguide and the slits is complex. Therefore, Applicants submit that the present invention described in claim 29 is not identical to the invention of reference 1, and the present invention has novel features compared to reference 1.

For at least this reasons, Applicants submit that dependent claim 29 patentably defines over the reference 1.

Regarding references 2 and 4 and new claims 24, 25, and 28 (similar to original claims 1, 2, and 9), in the present invention of new claim 24, a plurality of linear and rectangular waveguides for transmitting microwaves are provided in contact with the vacuum chamber. In the present invention of new claim 25, the rectangular waveguides are provided in contact with the electromagnetic wave radiation windows. On the other hand, in reference 2, the dielectric line is provided on the reaction chamber via the air gap. Thus, according to the inventions of new claims 24 and 25, uniform microwaves can be transmitted into the vacuum chamber. In addition, in reference 2, as cited in the fifth prior art in the paragraph "Description of Related Art" of the specification for the present application, an electric field

is formed in the reaction chamber by the dielectric line, and the plasma generation process differs greatly. There is also the problem that the footprint of the plasma processing apparatus is increased. In the inventions of new claims 24 and 25, the adjacent waveguides of the plurality of rectangular waveguides provided on the vacuum chamber are in contact with each other at their elongated side faces.

On the other hand, in reference 3, as cited in the third prior art in the paragraph "Description of Related Art" of the specification for the present application, a plurality of waveguides are arranged at considerable intervals. Thus, the structures of the invention of reference 3 and the inventions of new claims 24 and 25 are different in the arrangement of the waveguides. As new claim 28 depends on new claim 25, the structure of the invention of new claim 28 also differs from that of references 2 and 3.

Therefore, Applicants submit that the inventions of independent claims 24 and 25, and dependent claim 28 cannot be easily obtained even by combining references 2 and 3.

For at least these reasons, Applicants submit that independent claims 24 and 25 patentably define over the applied references.

Regarding references 2, 3, and 4, and new claim 24 (similar to original claim 1), independent claim 24 defines that: (a) the rectangular waveguides for transmitting microwaves are provided in contact with the vacuum chamber; (b) the adjacent waveguides of the plural rectangular waveguides are in contact with each other at their elongated side faces; and (c) the transmission path of the electromagnetic waves is bent through substantially 90° to the plurality of linear and rectangular waveguides from the electromagnetic wave distributing waveguide. On the other hand, reference 2 discloses a structure for transmitting the microwaves in a straight line between the microwave oscillator and the dielectric line. In reference 3, as cited in the third prior art in the paragraph

"Description of Related Art" of the specification for the present application, there is no technical disclosure for the distributing waveguide. Applicants submit that, as the waveguide was arranged considering diffusion of the plasma, it was difficult to distribute the plasma uniformly. There was also the problem that the number of points where the vacuum must be ensured is increased, and the processing costs of the vacuum chamber were increased.

Reference 4 discloses that the electromagnetic waves are bent through substantially 90° when the electromagnetic waves are branched from the waveguide and distributed to the radiative parts (Fig. 7A and 7B). Thus, the structure of new claim 24 is different from that of references 2, 3, and 4. In the present invention of new claim 24, uniform microwaves can be transmitted into the vacuum chamber by the structure of the above items (a) and (b), and a compact plasma processing apparatus can be provided by the structure of above item (c). An advantage of the compact plasma processing apparatus is to provide a plurality of plasma processing apparatuses using a limited number of clean rooms. However, this advantage of and the structures defined in independent claim 24 are not suggested in references 2, 3, and 4 or a combination thereof.

For at least these reasons, Applicants submit that independent claim 24 patentably defines over the applied references.

Regarding new claim 26 (similar to original claim 5), dependent claim 26 depends on independent claim 24 and has a structure in which the shortest distance between the opposite surfaces of each of the adjacent waveguides is not larger than the width between the facing inner surfaces of each of the rectangular waveguides.

For at least this reason, Applicants submit that claim 26 patentably defines over the applied references.

Regarding references 1 and 6 and new claim 30 (similar to original claim 15), claim 30 depends on indepedent claim 25 and has a structure in which a plurality of the electromagnetic wave radiation windows are hermetically arranged in a manner to correspond commonly to the plural slots, and the vacuum condition is maintained between the plural electromagnetic wave radiation windows and the vacuum chamber.

On the other hand, reference 1 discloses a ring-shaped waveguide. Reference 6 does not explain the relationship between the length in the major axis direction of the waveguide and the length in the major axis direction of the rectangular electromagnetic wave radiation window in the specification or the drawings.

As described above, the structure of the present invention of claim 30 is different from the structure of references 1 and 6, and references 1 and 6 do not suggest an advantage of making the electromagnetic wave radiation window thin by such a structure of amended claim 7. Therefore, Applicants submit that the present invention of claim 30 cannot be easily provided by combining references 1 and 6 without improper hindsight reconstruction.

For at least these reasons, Applicants submit that claim 26 patentably defines over the applied references.

Regarding references 1, 6, and 7 and new claim 31 (similar to original claim 16), dependent claim 31 has a structure in which mainly a major axis direction of the rectangular waveguide substantially coincides with that of the electromagnetic wave radiation window, a length in the major axis direction of the rectangular waveguide substantially coincides with that of the electromagnetic wave radiation windows, and a period of the major axis direction of the rectangular waveguide substantially coincides with that of the electromagnetic wave radiation windows. Moreover, claim 30 depends on independent claim 24.

For at least these reasons, Applicants submit that claim 30 patentably defines over the applied references.

Regarding references 1, 6, 7, and 8 and new claim 32 (similar to original claim 17), dependent claim 32 has a structure in which a length in the major axis direction of the electromagnetic wave radiation windows is shorter than that of the rectangular waveguides. Moreover, claim 32 depends on dependent claim 31 which depends on independent claim 24.

For at least these reasons, Applicants submit that claim 32 patentably defines over the applied references.

Furthermore, Applicants have considered the references made of record and not applied, and find these references no more pertinent to the question of patentability than the applied references.

Conclusion:

Consequently, in view of foregoing discussion and present amendments, it is respectfully submitted that this application is in condition for allowance. An early and favorable action is therefore respectfully requested.

Respectfully submitted,

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